

Analysis of Subgoal Data in Computer Science Principles - Data Cleaning

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- **Introduction**
- **Data Extraction**
- **Data Transformation**
- **Data Cleaning**
- **Data Validation**
- **Conclusion**

- **Introduction**

- Evaluation of the effectiveness of students learning to solve programming problems.
- Use of subgoal labels within Code.org Computer Science Principles online course.

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- Creation of automated processes to transform and clean the data from Code.org.

- # Data extraction

The screenshot displays the Code.org interface for Lesson 4: Using Simple Commands. The top navigation bar includes a 'Share' button, a 'Remix' button, the lesson title 'Lesson 4: Using Simple Commands', a progress indicator with 10 dots (the 4th dot is green), and a user profile 'Hari'. The main content area is divided into two sections. The top section, titled 'Instructions', contains a list of instructions under the heading 'Do This:'. A red bracket on the right side of this section is labeled 'Level'. The bottom section, titled 'Workspace', contains a 'Toolbox' on the left with 'Turtle' and 'Goals' categories. The 'Turtle' category is selected, showing 'moveForward()', 'turnLeft()', and 'Run' buttons. The 'Workspace' on the right shows a sequence of code blocks: a comment '//Move turtle', a 'moveForward()' block, a comment '//Orient turtle', a 'turnLeft()' block, another comment '//Move turtle', another 'moveForward()' block, another comment '//Orient turtle', and another 'turnLeft()' block. A red arrow points from the text 'Subgoal comment' to the first comment block. The 'Run' button is highlighted in orange.

Lesson 4: Using Simple Commands
Saved 7 months ago

Share Remix

Instructions

Do This:

- Don't add any code, just click `Run` and notice the following:
- In the workspace we've added the subgoals `//Move turtle` and `//Orient turtle` a few places in the code. ([Show me](#))
- Underneath each subgoal, we've added the blocks to complete the subgoal.
- The point is to simply notice that the subgoals don't change the drawing or what the turtle does.
- The turtle is still only controlled by the blue turtle command blocks

After running the program, click `Finish` to move on to try it yourself.

Toolbox

Turtle

Goals

moveForward()

turnLeft()

Run

Workspace:

Version History

Show Text

```
1 //Move turtle
2 moveForward();
3 //Orient turtle
4 turnLeft();
5 //Move turtle
6 moveForward();
7 //Orient turtle
8 turnLeft();
9
```

Subgoal comment

Level

- **Data extraction**

- Understanding data structure
 - Nine tables
 - Three types of assessments
 - App Lab levels
 - Multiple-Choice questions
 - Free response levels
 - Different types of subgoal comments
- Challenge
 - Scattered data are difficult to analyze

- **Data transformation**

- Convert the data structure to two-dimensional table for each assessment type.

	AppLab	Free Response	Multiple-choice
Level	10	21	79
Subgoal comment or keyword	9	10	
Number of columns	90	210	79

- **Data transformation**

- Automated processes developed in SQL stored procedures
 - Create two-dimensional tables
 - Iterate on the list of levels
 - Iterate on the list of subgoal comments
 - Create a column for each level with each subgoal comment
 - E.g.: Level1_loop, Level1_moveturtle
 - Migrate data
 - Iterate on the list of students, levels and responses
 - Insert each value into its corresponding cell

- **Data cleaning**

- Remove unnecessary data
 - Data for students who did not answer
 - Five or more applab levels
 - Four or more multi-choice questions
 - Four or more free response levels
- Remove inconsistency
 - Data for students who were not found in all three tables

- **Data validation**

- Check the number of columns
- Randomly check the accuracy of the cells

• Research results

- How do students use subgoal comment blocks throughout the unit?

Subgoal Prompted	# times subgoal used (average # of students)	% of students
Move turtle ($M = 11.4$, $SD = 13.6$)	1-3 times (50 students)	8%
	4 times (527)	26%
	5-16 times (30)	18%
	17-20 times (100)	19%
	21-100 times (<18)	15%
Orient turtle ($M = 10.3$, $SD = 12.8$)	1-2 times (45)	4%
	3 times (488)	24%
	4-14 times (36)	19%
	15-19 times (92)	21%
	20-84 times (<20)	15%
Define function ($M = 1.4$, $SD = 2.6$)	1-2 times (200)	19%
	3-8 times (50)	14%
	9-16 times (10)	5%
Call function ($M = 1.5$, $SD = 4.1$)	1-2 times (200)	20%
	3-8 times (25)	7%
	9-45 times (<10)	5%

Subgoal Explained	# times subgoal used (average # of students)	% of students
Move turtle ($M = 1.4$, $SD = 2.6$)	1-5 times (50 students)	21%
	6-22 times (<14)	9%
Orient turtle ($M = 1.7$, $SD = 2.1$)	1 time (113)	6%
	2-4 times (75)	11%
	5-10 times (<20)	4%
Define function ($M = 0.4$, $SD = 0.8$)	1 time (157)	8%
	2 times (38)	2%
	3-9 times (<10)	1%
Call function ($M = 0.4$, $SD = 0.8$)	1 time (156)	8%
	2-9 times (<12)	3%

Subgoal None	# times subgoal used (average # of students)	% of students
Move turtle ($M = 1.2$, $SD = 4.9$)	1-4 times (50 students)	10%
	5-47 times (<15)	7%
Orient turtle ($M = 1.0$, $SD = 4.4$)	1-2 times (65)	7%
	3-8 times (15)	6%
	9-65 times (<10)	3%
Define function ($M = 1.0$, $SD = 3.3$)	1 time (121)	6%
	2-8 times (30)	11%
	9-45 times (<10)	3%
Call function ($M = 1.0$, $SD = 3.4$)	1-2 times (150)	15%
	3-7 times (40)	9%
	8-25 times (<10)	3%

Thank you!